The Multi-Angle Imager for Aerosols (MAIA) investigation: application of spaceborne spectropolarimetry to speciated airborne particulate matter exposure and human health

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Inhalation of airborne particulate matter (PM) has been linked to a variety of human health impacts, including cardiovascular and respiratory disease, low birth weights, and premature deaths. While many studies have focused on the effects of exposure to the mass concentration of PM2.5 and PM10, the relative toxicity of different compositional mixtures of PM is less well understood. To address this issue, we are developing the Multi-Angle Imager for Aerosols (MAIA) investigation [1]. A key project element is the satellite-based MAIA instrument, consisting of a UV/VNIR/SWIR pushbroom spectropolarimetric camera mounted on a bi-axial gimbal. It is currently scheduled for launch in mid-2022 on the General Atomics Orbital Test Bed-2 (OTB-2) spacecraft. Three of the 14 spectral bands in the MAIA camera are polarized. Dual photoelastic modulators (PEMs) and a high-speed focal plane readout are used to acquire accurate measurements of the degree of linear polarization. The along-track (scan) gimbal axis enables multi-angle observations (up to ±60º at the instrument) in a "step and stare" observing mode, while the cross-track (pan) gimbal axis provides the instrument with a wide (±45º) field of regard and the capability to observe selected targets 3-4 times per week. Total and fractional aerosol optical depth and column effective aerosol optical and microphysical properties will be derived from these measurements at 1-km spatial resolution. In conjunction with geospatial data such as population and roadway densities, meteorological information such as boundary layer height and wind speed from the Weather Research and Forecasting model coupled with Chemistry (WRF-Chem), and measurements from surface-based PM monitors, a geostatistical regression modeling framework will be used to generate speciated PM maps over a set of major metropolitan areas distributed around the world. Birth, death, and hospitalization records will be used in epidemiological studies aimed at linking exposure to speciated PM with adverse health effects.

References

[1] Diner, D. J., *et al*., 2018: Advances in multiangle satellite remote sensing of speciated airborne particulate matter and association with adverse health effects: from MISR to MAIA. *J. Appl. Rem. Sens.* **12**, 042603. doi:10.1117/1.JRS.12.042603

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